```
/*
TinyTrackGPS.cpp - A simple track GPS to SD card logger.
TinyTrackGPS v0.13

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rafael.reyes.carmona@gmail.com

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*/

/*************************************************************************
/  Programa de localizacion por gps que graba las posiciones en
/  un fichero de texto cada segundo, de forma diaria.
/
/  - Conectar módulo SD con pin CS (naranja) en pin 10 arduino.
/
/  Uso de librería TinyGPS.
/   Requiere uso de librería SoftwareSerial, se presupone que disponemos
/   de un dispositivo GPS serie de 9600-bauds conectado en pines 9(rx) y 8(tx).
/  - Conectar módulo NMEA-6M (gps) pines 8,9 (9 - pin rx negro)
/
/  - Conectar LCD 16x2 pines 2,3,4,5,6,7 (2-amarillo , 3-azul,
/     4-rojo, 5-azul oscuro, 6-verde, 7-blanco)
/
/  - Conectar OLED 0.96" en SDA y SCL. pines A4 y A5 del Arduino UNO.
*************************************************************************/

// Include libraries.
#include <Arduino.h>
#include "config.h"
#include "Display.h"
//#include <SoftwareSerial.h>
#include "TinyGPS_GLONASS_fixed.h"
#if defined(__LGT8F__)
#include <LowPower.h>
#endif
#include "SdFat.h"
#include "Vcc.h"
#include <sdios.h>
#include <UTMConversion.h>
#include <Timezone.h>
#if defined(TIMEZONE_FILE)
#include "ConfigFile.h"
#endif
```

```
// Definimos el Display
#if defined(DISPLAY_TYPE_LCD_16X2)
Display LCD(LCD_16X2);
#elif defined(DISPLAY_TYPE_LCD_16X2_I2C)
Display LCD(LCD_16X2_I2C);
#elif defined(DISPLAY_TYPE_SDD1306_128X64)
Display LCD(SDD1306_128X64);
#elif defined(DISPLAY_TYPE_SH1106_128X64)
Display LCD(SDD1306_128X64);
#elif defined(DISPLAY_TYPE_SDD1306_128X64_lcdgfx)
Display LCD(SDD1306_128X64);
#else
#define NO_DISPLAY
#include <LowPower.h>
#endif

// Chip select may be constant or RAM variable.
const uint8_t SD_CS_PIN = 10;

// Pin numbers in templates must be constants.
const uint8_t SOFT_MISO_PIN = 12;
const uint8_t SOFT_MOSI_PIN = 11;
const uint8_t SOFT_SCK_PIN  = 13;

// SdFat software SPI template
SoftSpiDriver<SOFT_MISO_PIN, SOFT_MOSI_PIN, SOFT_SCK_PIN> softSpi;
// Speed argument is ignored for software SPI.
#if ENABLE_DEDICATED_SPI
#define SD_CONFIG SdSpiConfig(SD_CS_PIN, DEDICATED_SPI, SD_SCK_MHZ(0), &softSpi)
#else  // ENABLE_DEDICATED_SPI
#define SD_CONFIG SdSpiConfig(SD_CS_PIN, SHARED_SPI, SD_SCK_MHZ(0), &softSpi)
#endif  // ENABLE_DEDICATED_SPI

SdFat card;   //SdFat.h library.
File file;
bool SDReady;
bool SaveOK;

// Variables y clases para obtener datos del GPS y conversion UTM.
TinyGPS gps;
GPS_UTM utm;
//SoftwareSerial gps_serial(9, 8);
#define gps_serial Serial   // Uses Serial to read GPS info.
int year_gps;
//byte month_gps, day_gps, hour_gps, minute_gps, second_gps;
float flat, flon;
unsigned long age;
unsigned int elev;

// Variables para configurar Timezone.
#ifndef TIMEZONE_FILE
// Central European Time (Frankfurt, Paris) See below for other zone.
TimeChangeRule CEST = {"CEST", Last, Sun, Mar, 2, 120};     // Central European
Summer Time
TimeChangeRule CET = {"CET ", Last, Sun, Oct, 3, 60};       // Central European
Standard Time
Timezone CE(CEST, CET);
#define TimeZone CE
#else
TimeChangeRule UT = {"UTC", Last, Sun, Mar, 1, 0};     // UTC
```

```
TimeChangeRule UST;
Timezone TimeZone(UT);

// Loads the configuration from a file
bool loadConfiguration(TimeChangeRule *UST,TimeChangeRule *UT) {

  boolean file;
  uint8_t read;
  ConfigFile<12> TimeConf;

  if((file = TimeConf.begin("Time.cfg"))){
    read = 0;
    while(TimeConf.readNextSetting()){

      char opt[5];
      strcpy(opt,TimeConf.getName());

      if (!strcmp(opt,"USTw")) {
        read++;
        UST->week = TimeConf.getIntValue();
      }
      else if (!strcmp(opt,"USTd")) {
        read++;
        UST->dow = TimeConf.getIntValue();
      }
      else if (!strcmp(opt,"USTm")) {
        read++;
        UST->month = TimeConf.getIntValue();
      }
      else if (!strcmp(opt,"USTh")) {
        read++;
        UST->hour = TimeConf.getIntValue();
      }
      else if (!strcmp(opt,"USTo")) {
        read++;
        UST->offset = TimeConf.getIntValue();
      }

      else if (!strcmp(opt,"UTw")) {
        read++;
        UT->week = TimeConf.getIntValue();
      }
      else if (!strcmp(opt,"UTd")) {
        read++;
        UT->dow = TimeConf.getIntValue();
      }
      else if (!strcmp(opt,"UTm")) {
        read++;
        UT->month = TimeConf.getIntValue();
      }
      else if (!strcmp(opt,"UTh")) {
        read++;
        UT->hour = TimeConf.getIntValue();
      }
      else if (!strcmp(opt,"UTo")) {
        read++;
        UT->offset = TimeConf.getIntValue();
      }
    /*
    // Put a nameIs() block here for each setting you have.
```

```
    //if(TimeConf.nameIs("USTabbre"))
    //  strcpy(UST.abbrev,"UST");

    if(TimeConf.nameIs("USTw"))
      UST->week = TimeConf.getIntValue();
    else if(TimeConf.nameIs("USTd"))
      UST->dow = TimeConf.getIntValue();
    else if(TimeConf.nameIs("USTm"))
      UST->month = TimeConf.getIntValue();
    else if(TimeConf.nameIs("USTh"))
      UST->hour = TimeConf.getIntValue();
    else if(TimeConf.nameIs("USTo"))
      UST->offset = TimeConf.getIntValue();

    //else if(TimeConf.nameIs("UTabbre"))
    //  strcpy(UST.abbrev,"UT");
    else if(TimeConf.nameIs("UTw"))
      UT->week = TimeConf.getIntValue();
    else if(TimeConf.nameIs("UTd"))
      UT->dow = TimeConf.getIntValue();
    else if(TimeConf.nameIs("UTm"))
      UT->month = TimeConf.getIntValue();
    else if(TimeConf.nameIs("UTh"))
      UT->hour = TimeConf.getIntValue();
    else if(TimeConf.nameIs("UTo"))
      UT->offset = TimeConf.getIntValue();
    */
    strcpy(UST->abbrev,"UST");
    strcpy(UT->abbrev,"UT");
  }
  }
  TimeConf.end();

  //Serial.print(UST->offset);
  //Serial.println(UST->abbrev);
  //Serial.print(UT->offset);
  //Serial.println(UT->abbrev);

  if(read == 10) return true;
  return false;
}
#endif
// Variables para gestionar el tiempo local.
TimeElements time_gps;
time_t utctime;
time_t localtime;
time_t prevtime;

//------------------------------------------------------------------------------
/*
 * User provided date time callback function.
 * See SdFile::dateTimeCallback() for usage.
 */
void dateTime(uint16_t* date, uint16_t* time) {
  // User gets date and time from GPS or real-time
  // clock in real callback function

  // return date using FAT_DATE macro to format fields
  //*date = FAT_DATE(year, month, day);
  *date = (year(localtime)-1980) << 9 | month(localtime) << 5 | day(localtime);
```

```
238
239   // return time using FAT_TIME macro to format fields
240   //*time = FAT_TIME(hour, minute, second);
241   *time = hour(localtime) << 11 | minute(localtime) << 5 | second(localtime) >> 1;
242 }
243 //------------------------------------------------------------------------------
244
245 #ifndef NO_DISPLAY
246 #if defined(DISPLAY_TYPE_LCD_16X2) || defined(DISPLAY_TYPE_LCD_16X2_I2C)
247 bool pinswitch();
248 #endif
249 #endif
250 //void GPSRefresh();
251 #if defined(DISPLAY_TYPE_LCD_16X2) || defined(DISPLAY_TYPE_LCD_16X2_I2C)
252 unsigned long iteration = 0;
253 #endif
254
255 #define BAT_MIN  3.250
256 #define BAT_MAX  4.250
257 #define BAT_MIN_mV  3250
258 #define BAT_MAX_mV  4250
259 #define ALFA_BAT   1.0e2  // 100 / (BAT_MAX - BAT_MIN) -> 0..100%
260 #define BETA_BAT   2.5e1  // ALFA_BAT / 4 -> 0..25
261
262 Vcc vcc(1.0);
263
264 uint8_t charge_level(){
265     //float f_charge = (vcc.Read_Volts() * BETA_BAT) - (BAT_MIN * BETA_BAT);
266     //int i_charge = (int)f_charge;
267     //uint8_t charge = constrain(i_charge, 0, 26);
268     //return charge;
269     //float f_charge = vcc.Read_Perc(BAT_MIN,BAT_MAX);
270     //int i_charge = (int)f_charge;
271     //return (i_charge >> 2);
272     uint16_t charge = map(vcc.Read_Volts_fast(),BAT_MIN_mV,BAT_MAX_mV,0,25);
273     return (constrain(charge,0,25));
274 }
275
276 bool GPSData(TinyGPS &gps, GPS_UTM &utm) {
277   static bool save = false;
278   char GPSLogFile[13];
279
280   sprintf(GPSLogFile, "%04d%02d%02d.csv", year(localtime), month(localtime),
    day(localtime));
281
282   //SdFile::dateTimeCallback(dateTime);
283   FsDateTime::setCallback(dateTime);
284
285   // Si no existe el fichero lo crea y añade las cabeceras.
286   if (SDReady && !card.exists(GPSLogFile)) {
287     if (file.open(GPSLogFile, O_CREAT | O_APPEND | O_WRITE)) {
288       //Serial.print(F("New GPSLogFile, adding heads..."));
289       file.println(F("Time,Latitude,Longitude,Elevation,UTM Coords(WGS84)"));
290       //Serial.println(F("Done."));
291       file.close();
292       }
293       //else {
294       //Serial.println(F("** Error creating GPSLogFile. **"));
295       //}
296   }
```

```
297   if (SDReady && (file.open(GPSLogFile, O_APPEND | O_WRITE))) {
298     //Serial.print(F("Open GPSLogFile to write..."));
299     char str[19];
300     char comma = 0X2c;
301 
302     sprintf(str, "%02d:%02d:%02d", hour(localtime), minute(localtime),
    second(localtime));
303     file.print(str);
304     file.print(comma);
305     file.print(flat,6);
306     file.print(comma);
307     file.print(flon,6);
308     file.print(comma);
309     file.print(elev);
310     file.print(comma);
311     sprintf(str, "%02d%c %ld %ld", utm.zone(), utm.band(), utm.X(), utm.Y());
312     file.print(str);
313     file.print("\n");
314     file.close();
315     save = true;
316     //Serial.println(F("Done."));
317   } //else {
318     //Serial.println(F("** Error opening GPSLogFile. **"));
319   //}
320   //} //else Serial.println(F("** GPS signal lost. **"));
321   return (save && SDReady);
322 }
323 
324 #ifndef NO_DISPLAY
325 void ScreenPrint(Display &LCD, TinyGPS &gps, GPS_UTM &utm){
326 
327   unsigned short sats;
328 
329   sats = gps.satellites();
330   #if defined(DISPLAY_TYPE_LCD_16X2) || defined(DISPLAY_TYPE_LCD_16X2_I2C)
331     bool print_utm = false;
332     bool print_grades = false;
333 
334   if (!pinswitch()) print_utm = true;
335   else print_grades = true;
336 
337   if (print_utm) {
338   #endif
339     char line[12];
340     #if defined(DISPLAY_TYPE_SDD1306_128X64_lcdgfx)
341     sprintf(line, "%02d%c?%ld?", utm.zone(), utm.band(), utm.X());
342     #else
343     sprintf(line, "%02d%c %ld ", utm.zone(), utm.band(), utm.X());
344     #endif
345     //Serial.println(line);
346     LCD.print(0,0,line);
347     LCD.print_PChar((byte)6);
348     #if defined(DISPLAY_TYPE_SDD1306_128X64_lcdgfx)
349     sprintf(line, "%02hu?", sats);
350     #else
351     sprintf(line, "%02hu ", sats);
352     #endif
353     //Serial.println(line);
354     LCD.print(12,0,line);
355     (SaveOK) ? LCD.print_PChar((byte)7) : LCD.print("-");
```

```
356
357     // New line
358     #if defined(DISPLAY_TYPE_SDD1306_128X64_lcdgfx)
359     sprintf(line, "%ld?", utm.Y());
360     #else
361     sprintf(line, "%ld ", utm.Y());
362     #endif
363     //Serial.println(line);
364     LCD.print(1,1,line);
365     LCD.print_PChar((byte)5);
366     #if defined(DISPLAY_TYPE_SDD1306_128X64_lcdgfx)
367     sprintf(line, "%u@", elev);
368     #else
369     sprintf(line, "%um", elev);
370     #endif
371     //Serial.println(line);
372
373     unsigned int elev_n = elev;
374     byte n = 1;
375     while (elev_n > 9){
376       elev_n /= 10;
377       n++;
378     }
379     #if defined(DISPLAY_TYPE_LCD_16X2) || defined(DISPLAY_TYPE_LCD_16X2_I2C)
380     for(byte i = 5-n; i>0; i--) LCD.print(9+i,1," ");
381     #elif defined(DISPLAY_TYPE_SDD1306_128X64_lcdgfx)
382     for(byte i = 5-n; i>0; i--) LCD.print(9+i,1,"?");
383     #endif
384     LCD.print(15-n,1,line);
385
386     /*
387     if (elev < 10) LCD.print(14,1,line);
388     else if (elev < 100) LCD.print(13,1,line);
389     else if (elev < 1000) LCD.print(12,1,line);
390     else LCD.print(11,1,line);
391     */
392   #if defined(DISPLAY_TYPE_LCD_16X2) || defined(DISPLAY_TYPE_LCD_16X2_I2C)
393   }
394
395   if (print_grades) {
396     static char line[11];
397   #endif
398     #if defined(DISPLAY_TYPE_SDD1306_128X64_lcdgfx)
399     LCD.print(0, 2, "LAT/");
400     #else
401     LCD.print(1,(LCD.display_type() == SDD1306_128X64) ? 2 : 0,"LAT=");
402     #endif
403     dtostrf(flat, 8, 6, line);
404     LCD.print(line);
405
406     #if defined(DISPLAY_TYPE_SDD1306_128X64_lcdgfx)
407     LCD.print(0, 3,"LON/");
408     #else
409     LCD.print(1,(LCD.display_type() == SDD1306_128X64) ? 3 : 1,"LON=");
410     #endif
411     dtostrf(flon, 8, 6, line);
412     LCD.print(line);
413   }
414 #if defined(DISPLAY_TYPE_LCD_16X2) || defined(DISPLAY_TYPE_LCD_16X2_I2C)
415 }
```

```
416
417 bool pinswitch() {
418   static bool prevpin = 0;
419   static bool pin = 0;
420   unsigned long time;
421   time = millis();
422
423   pin = bitRead(time,13); // Change every 8192 miliseconds.
424
425   if (prevpin^pin) LCD.clr(); // Clear display when change between modes.
426
427   return pin;
428 }
429 #endif
430 #endif
431
432 inline void set_time(){
433 //static TimeElements time_gps;
434
435   time_gps.Year = year_gps - 1970;
436   //time_gps.Month = month_gps;
437   //time_gps.Day = day_gps;
438   //time_gps.Hour = hour_gps;
439   //time_gps.Minute = minute_gps;
440   //time_gps.Second = second_gps;
441
442   utctime = makeTime(time_gps);
443   localtime = TimeZone.toLocal(utctime);
444 }
445
446 void setup(void) {
447   #if defined(__LGT8F__)
448   ECCR = 0x80;
449   ECCR = 0x00;
450   #endif
451   delay(100);
452   //Serial.begin(9600);
453   gps_serial.begin(9600);
454
455   //Serial.print(F("Initializing SD card..."));
456
457   SDReady = card.begin(SD_CONFIG);
458   //(SDReady) ? Serial.println(F("Done.")) : Serial.println(F("FAILED!"));
459
460   // Config TimeZone (localtime) with 'Time.cfg' file on SD.
461   #if defined(TIMEZONE_FILE)
462   if(loadConfiguration(&UST,&UT)) TimeZone.setRules(UST,UT);
463   #endif
464
465   /* Iniciaización del display LCD u OLED */
466   #ifndef NO_DISPLAY
467   LCD.start();
468   #endif
469
470   //Serial.print(F("Waiting for GPS signal..."));
471   #ifndef NO_DISPLAY
472   #if defined(DISPLAY_TYPE_LCD_16X2) || defined(DISPLAY_TYPE_LCD_16X2_I2C) ||
defined(DISPLAY_TYPE_SDD1306_128X64) || defined(DISPLAY_TYPE_SH1106_128X64)
473   LCD.print(NAME, VERSION,"Waiting GPS",UT.abbrev);
474   #elif defined(DISPLAY_TYPE_SDD1306_128X64_lcdgfx)
```

```
  #if defined(__LGT8F__)
  LCD.DrawLogo();
  LCD.print(3,UT.abbrev);
  #else
  LCD.print(NAME_M, VERSION,UT.abbrev);
  #endif
  #endif
  unsigned int time = 0;
  #endif

  bool config = false;

  do {
    #ifndef NO_DISPLAY
    LCD.wait_anin(time++);
    #if defined(DISPLAY_TYPE_SDD1306_128X64_lcdgfx)
    LCD.drawbattery(charge_level());
    #endif
    #endif
    for (unsigned long start = millis(); millis() - start < 1000;) {
      while (gps_serial.available() > 0) {
        char c = gps_serial.read();
        //Serial.write(c); // uncomment this line if you want to see the GPS data flowing
        if (gps.encode(c)) {// Did a new valid sentence come in?
//          gps.crack_datetime(&year_gps, &month_gps, &day_gps, &hour_gps, &minute_gps, &second_gps, NULL, &age);
          gps.crack_datetime(&year_gps, &time_gps.Month, &time_gps.Day, &time_gps.Hour, &time_gps.Minute, &time_gps.Second, NULL, &age);
          (age != TinyGPS::GPS_INVALID_AGE) ? config = true : config = false;
        }
      }
    }
  }while(!config);

  set_time();
  prevtime = utctime;
  //Serial.println(F("Done."));
  //Serial.println(F("Configuration ended."));
  #ifndef NO_DISPLAY
  LCD.clr();
  #endif
}

void loop(void) {
  static bool gps_ok = false;
  uint8_t charge;
  uint8_t errorSD;

  while (gps_serial.available() > 0) {
    char c = gps_serial.read();
    //Serial.write(c); // uncomment this line if you want to see the GPS data flowing
    if (gps.encode(c)) {// Did a new valid sentence come in?
//      gps.crack_datetime(&year_gps, &month_gps, &day_gps, &hour_gps, &minute_gps, &second_gps, NULL, &age);
      gps.crack_datetime(&year_gps, &time_gps.Month, &time_gps.Day, &time_gps.Hour, &time_gps.Minute, &time_gps.Second, NULL, &age);
      (age != TinyGPS::GPS_INVALID_AGE) ? gps_ok = true : gps_ok = false;
      if(!SDReady)
```

```
529         if(card.cardBegin(SD_CONFIG)) SDReady = card.begin(SD_CONFIG);
530       }
531     }
532
533     gps.f_get_position(&flat, &flon, &age);
534     if ((elev = gps.altitude()) == TinyGPS::GPS_INVALID_ALTITUDE) elev = 0;
535     else elev /= 100L;
536     utm.UTM(flat, flon);
537
538     set_time();
539
540     //Serial.println(utctime);
541     //Serial.println(localtime);
542
543     charge = charge_level();
544
545     if (gps_ok && (charge>0)) {
546       if (utctime > prevtime) {
547         (!(errorSD = card.sdErrorCode())) ? SDReady = true : SDReady = false;
548         if (errorSD == 11) card.end();
549         //Serial.println(errorSD);
550         if (!errorSD) SaveOK = GPSData(gps, utm);
551         else SaveOK = false;
552         prevtime = utctime;
553         #if defined(DISPLAY_TYPE_LCD_16X2) || defined(DISPLAY_TYPE_LCD_16X2_I2C)
554         iteration++;
555         #endif
556       }
557       #ifndef NO_DISPLAY
558       ScreenPrint(LCD, gps, utm);
559       gps_ok = false;
560     } else if (charge==0){
561         LCD.clr();
562       #endif
563     }
564
565     #if defined(DISPLAY_TYPE_SDD1306_128X64_lcdgfx)
566     LCD.drawbattery(charge);
567     #endif
568
569     #if defined(__LGT8F__)
570     LowPower.idle(SLEEP_120MS, ADC_ON, TIMER2_OFF, TIMER1_OFF, TIMER0_OFF, SPI_ON,
    USART0_ON, TWI_ON);
571     #endif
572
573     #ifdef NO_DISPLAY
574     LowPower.idle(SLEEP_120MS,ADC_ON, TIMER2_OFF, TIMER1_OFF, TIMER0_OFF, SPI_ON,
    USART0_ON, TWI_ON);// para NO_DISPLAY.
575     #endif
576 }
577
```